REVISED -

Physiological and Biochemical Effect of Common Pyrethroids on *Cirrhinus reba* (Hamilton).

SYNOPSIS (Revised)

Proposed outline of the Research Work for Ph.D Degree in Zoology

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Manoj 01/12/2025

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Title of Research:

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1. Introduction

India is primarily an agro-based country, and large-scale dependence on agriculture has led to the heavy use of synthetic insecticides. The green, white and blue revolutions have remarkably improved agricultural productivity but also contributed to serious environmental pollution, particularly in freshwater ecosystems. More than 30% of agricultural yield is still lost due to pests, which promotes further chemical insecticide application. Among them, **synthetic pyrethroids** have become the most widely used modern insecticides due to their high potency, rapid knock-down action and comparatively low persistence in the environment. However, numerous studies have shown that pyrethroids disrupt the **ionic permeability of neuronal membranes** and act as **neuro-excitatory poisons**, posing considerable ecological risk. Water polluted by agricultural runoff frequently exposes fish to pyrethroids, resulting in various **physiological, biochemical and behavioral disturbances**. Fish absorb pesticides through their gills, integument, gastro-intestinal tract and contaminated food, leading to bioaccumulation and biomagnification and creating direct implications for human consumers.

Cirrhinus reba (Hamilton), locally known as **Reba/Chala**, is an important freshwater carp with high nutritive value and commercial demand in Bihar. It contributes significantly to rural livelihoods and wetland productivity. In recent years, a decline in *C. reba* population has been observed in several freshwater bodies in the Kosi region, potentially linked to increasing pesticide contamination.

Given the ecological, nutritional and commercial importance of *Cirrhinus reba*, it becomes essential to investigate how **commonly used pyrethroids** like Cypermethrin, Lambda-cyhalothrin and Deltamethrin affect the **hematological profile, metabolism, enzymatic activity and overall physiology** of this fish species. The results will enhance risk assessment regarding pesticide contamination and assist in protecting aquatic biodiversity.

2. Origin of the Research Problem

The **Kosi region of Bihar**, rich in rivers, wetlands, oxbow lakes and floodplains, sustains diverse fish populations and supports the inland fisheries economy. However, during the last two decades, substantial anthropogenic disturbances—especially the **indiscriminate use of pesticides in agriculture**—have resulted in the progressive degradation of aquatic ecosystems.

Among impacted species, *Cirrhinus reba* has shown decreasing abundance, possibly due to physiological stress induced by chronic pesticide exposure. Pyrethroid residues are continuously detected in surface waters during the agricultural seasons, indicating long-term exposure risk even at sub-lethal levels. The lack of comprehensive toxicological studies on this species further widens the knowledge gap.

Therefore, this research aims to investigate the **effect of common pyrethroids like Cypermethrin, Lambda-cyhalothrin and Deltamethrin on biochemical constituents, enzymatic activity and hematological parameters of *Cirrhinus reba*** to understand the degree of physiological disruption and potential ecological consequences.

3. Objectives of the Study

1. To survey and collect updated literature on pyrethroid toxicity in freshwater teleosts of Bihar (survey limited to Saharsa, Madhepura and Supaul districts).
2. To examine the effect of selected common pyrethroids like Cypermethrin, Lambda-cyhalothrin and Deltamethrin on the **biochemical constituents** of *Cirrhinus reba* (total protein, free amino acids, nucleic acids etc.).
3. To analyze changes in **hematological and physiological parameters**, including RBC, Hb, PCV, glucose level and blood indices.
4. To estimate activities of important enzymes—**LDH, SDH, AChE and ATPase**—under pesticide exposure and controlled laboratory conditions.
5. To compare **acute and sub-lethal toxicity responses** of pyrethroids in *Cirrhinus reba*.
6. To help **sensitize local farmers** on the safe and minimal use of pyrethroids to ensure sustainable aquaculture and environmental conservation.

4. Hypothesis

It is hypothesized that **exposure to commonly used pyrethroids will cause significant alterations in the physiological functions, metabolic profile and biochemical constituents of *Cirrhinus reba*.** These alterations may impair growth, reproduction and survival, leading to decline in population and affecting freshwater biodiversity and nutrient cycling.

5. Methodology

- **Survey of literature & field information:** Discussions with fish farmers and review of published reports focusing on the Kosi region.
- **Collection and Acclimatization of Experimental Fish:**
  Healthy adult *Cirrhinus reba* (approx. length 3–5 inches, weight 10–50 g) will be collected locally and acclimatized for 7–10 days in de-chlorinated, aerated water under controlled conditions (temperature 24 ± 2°C, pH 7.0–7.2, DO 8–10 mg/L, hardness 20–25 mg/L $CaCO_3$).
- **Toxicity Studies:**
  Acute toxicity tests will be performed using **renewal static bioassay method** (Committee on Methods for Toxicity Tests with Aquatic Organisms, 1975). LC_{50} values will be determined using **Probit analysis** (Finney, 1971).

  Experimental design:

  - Group 1 — Control (unexposed)
  - Group 2 — Fish exposed to sub-lethal concentration of selected pyrethroid(s) like Cypermethrin, Lambda-cyhalothrin and Deltamethrin for 24, 48, 72 and 96 hours for LC_{50} Dtermination
  - Group 3 —Experimental Group
- **Biochemical and Enzymatic Analysis:**
  Total protein, total free amino acids, DNA, RNA, Serum glucose will be quantified. Enzymatic assays will include **LDH, SDH, ATPase and AChE** using standard protocols.
- **Hematological Profiling:**
  RBC count, WBC count, Hb concentration, PCV, MCV, MCH and MCHC will be measured to assess functional status of oxygen transport and physiological stress.

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- **Statistical Analysis:**

  Significance of observations will be evaluated using ANOVA .

6. Proposed Chapters of the Thesis

Chapter No.	Title
Chapter 1	Introduction
Chapter 2	Review of Literature
Chapter 3	Purpose and Hypothesis
Chapter 4	Materials and Methodology
Chapter 5	Results and Discussion
Chapter 6	Summary and Conclusion

7. Expected Outcomes

- *Identification of biochemical and physiological markers of pyrethroid toxicity in Cirrhinus reba*
- Understanding of acute vs. sub-lethal pesticide impact on freshwater fish physiology
- Recognition of ecological risks associated with pesticide runoff in aquatic systems
- Generation of scientific awareness to guide farmers toward **safe pesticide use**

REFERENCES:-

1. Abidi, R. and Srivastava, U.S. (1980). Effect of endosulfan on certain aspects of haematology of the fish, Channa punctatus. Proc. Natl. Acad. Sci.India 58B, 55-65.

2. Abou-Donia, M.B., Lapadul, D.M. and Carrington, C.D. 1988. Biochemical methods for assessment of neurotoxicity. In: Perspectives in basic and applied toxicology (Ed: B. Ballantyne). Butterworth & Co. Ltd., London, 1-30.

3. Adams K J, Chavasse DC, Mount DL, Carneiro IA, Curtis CF (2002) Comparative insecticidal power of three pyrethroids on netting. Med Vet Entomol 16:106–108.

4. Aderemi, F. A. (2004). Effects of replacement of wheat bran with cassava root sieviate supplemented or unsupplemented with enzyme on the haematology and serum biochemistry of pullet chicks. Tropical Journal of Animal Science, 7, 147-153.

5. Adhikari, S., Sarkar, B. (2004).Effect of Cypermethrin and Carbonfluron on certain haematological parameters and prediction of their recovery in a freshwater teleost, Laebeo rohita (Ham) Ecotoxicol. Environ. Safe. 58-220-226.

6. Affonso, E.G. (2001). Respiratory characteristics of Hoploternum littorale (Siluriformes, Callichthyidae); Acta Amazonica.31:249-262.

7. Afolabi, K. D., Akinsoyinu, A. O., Olajide, R., and Akinleye, S. B. (2010).

8. Agrawal V P and Tyagi M (1988) Haematological alterations in Ophiocephalus punctatus induced by endosulphan. In: National Symposium on Threatened Habitats, 28. Department of Zoology, Hindu College, Moradabad.

9. Ahmad S, Scopes R K, Rees G N and Patel B K C (2000)Saccharococcus caldoxylosilyticus sp. nov., an obligately thermophilic, xylose-utilizing, endospore-forming bacterium. Int. J. Syst. Evol. Microbiol. 50, 517- 523.

10. Akinrotimi, O. A., Abu O. M. G., Ansa, E. J., Edun O. M. and George, O. S. (2009), Haematological responses of Tilapia guineensis to acute stress. J Nat Appi Sci. Vol (5):338 – 343.

11. Al-Kahtani, M.A. (2011). Effect of an Insecticide Abamectin on Some Biochemical Characteristics of Tilapia Fish (Oreochromis Niloticus). American Journal of Agricultural and Biological Sciences, 6 (1): 62-68.

12. Al-Makkawy, H.K., Madbouly, M.D., 1999. Persistence and accumulation of some organic insecticides in Nile water and fish. Resour. Conser. Recycl. 27, 105–115.

13. Amacher, DE.: A toxicologist's guide to biomarkers of hepatic response, Human and Experimental Toxicology., 2002, 21, 253 -262.

14. Anandkumar A, Tripathy A P and Tripathy N K (2001). Effect of dimecron on the blood parameters of Heteropneustes fossilis. J. Environ. Biol. 22, 297-299.

14. Anandkumar A, Tripathy A P and Tripathy N K (2001). Effect of dimecron on the blood parameters of Heteropneustes fossilis. J. Environ. Biol. 22, 297-299.

15.Anita Susan, T., K. Veeraiah and K.S. Tilak, 1999. Biochemical and enzymatic changes in the tissues of Catla catla exposed to the pyrethroid fenvalerate. J. Ecobiol., 11: 109-116.

16.Anitha Susan, T.1999. Toxicity and effect of synthetic pyrethroid fenvalerate on the metabolism of the three Indian major carps Labeo rohita, Catla Catla and Cirrhinus mrigala (Ham). Ph.D. Thesis submitted to Nagarjuna University, A.P. India.

17. Anitha Susan, T., Veeriah, K and Tilak, K.S. (1999): Biochemical and enzymatic changes in the tissues of Catla catla exposed to the pyrethroid fenvalerate. J. Ecobiol., 11(2): 109-116.

18. Annamani AK (1986). Toxicity of Fenvalerate technical grade and 20% EC to Labeo rohita and Aplochelus panchax. M.Phil. Thesis, Acharya Nagarjuna University, Guntur, Andhra Pradesh, India.

19. Ansari, B.A. and Kumar, K. 1988. Cypermethrin Toxicity: Effect on the carbohydrate metabolism of the Indiancatfish, Hetropneustes fossilis – Sci. Total Environ., 72:161-166.

20. APHA. 1998. Standard Methods for the examination of water and waste water. (20th edn.), American Public Health Association, New York.

21. Apostol S. The toxicity of certain pesticides to protozoa. Proc Symp Environ Biol 1979 : 97-102.

22. Asztolas, B., Nemasok,J.,Benedeezky Gabrial, R, Szabo, A and Refarieo, J. (1990): The effect of pesticides on some biochemical parameters of carp C. carpio. Arch. Environ. Contam.Toxicol., 19: 257-280.

23.Babu velmurugan, Mariadoss selvanayagam, Elif I. Cengiz and Erhan Unlu: The Effects of Fenvalerate on different tissues of fresh water fish Cirrhinus mrigala. J. Environ. Sci. Hlth., Part-B, 42, 157-163 (2007).

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